DOCUMENT RESUME

ED 445 565 HE 033 008

AUTHOR Nnadozie, Emmanuel; Ishiyama, John; Chon, Jane
TITLE Undergraduate Research Internships and Graduate School Success.
PUB DATE 2000-04-00
NOTE 29p.
PUB TYPE Opinion Papers (120)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Graduate Study; Higher Education; *Internship Programs; *Low Income Groups; *Minority Groups; Outcomes of Education; Program Design; Program Evaluation; Student Evaluation; Student Research; Student Surveys; *Undergraduate Study; Writing for Publication
IDENTIFIERS *Ronald E McNair Postbaccalaureate Achievement Prog; *Truman State University MO

ABSTRACT

This paper summarizes findings of a survey of 157 Ronald E. McNair (DOE) research internship programs, which prepare first-generation, low-income, and under-represented minority students for entrance into and successful completion of graduate school programs. The hypothesis for the study was that more rigorous research experience was more likely to promote graduates' success in entering and persisting through graduate school. Following a discussion of the program components which directors thought were most effective, the paper examines the relationship between the characteristics of the internships and the degree of success in placing students in graduate school programs. Data is based on a 12-item questionnaire distributed to all 157 programs; 35 useable responses were received. The study found a weak relationship between preparation for the research internship and graduate school success. The findings suggest that three key elements--preparation, presentation, and publication--are generally absent from many programs, and the paper offers an example of a program at Truman State University (Missouri), an important component of which is pre-research internships for sophomore students. Students complete a series of introductory workshops, followed by a three-week pre-research internship which includes a proposal writing exercise that is publicly presented to and critiqued by a group of observers. Appended are 7 data tables. (Contains 14 references.) (RH)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 445 565

Undergraduate Research Internships and Graduate School Success

Emmanuel Nnadozie, John Ishiyama, Jane Chon
Ronald E. McNair Program
Adair Building
Truman State University
Kirksville, MO 63501
(660) 785-5393
ennadozi@truman.edu
jishiyam@truman.edu
jchon@truman.edu

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
E. Nnadozie
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

An earlier version of this paper was presented at the annual meeting of the Missouri, Kansas, Nebraska (MO-KAN-NE) Chapter of the Mid-America Association of Educational Opportunity Program Personnel in Kansas City, Missouri, 12-14 April, 2000.

BEST COPY AVAILABLE

HE 033 008

Undergraduate Research Internships and Graduate School Success

Abstract

This paper summarizes the findings from a survey conducted of McNair undergraduate research internships throughout the United States. We provide some descriptive data on the characteristics of the various programs nationwide, particularly with regards to the structure of the undergraduate research internship component of their programs, and the components program directors thought were most effective. Second, we investigate the relationships between the characteristics of the research internship and the degree of success experienced by the programs in placing students in graduate school programs.

In the past few years there has been a growing interest in assessing the impact of a substantial undergraduate research experience on student development. By and large these studies have focused on the beneficial aspects of participating in a research experience, particularly in promoting a sense of "academic integration" among the students (Tinto 1975; 1987). Nagda, Gregerman, Jonides, von Hippel, and Lerner (1998) have noted that the promotion of undergraduate research forges close student-faculty connections, and is particularly successful in promoting retention of higher risk students, especially African American students and students with low achievement. Volkwien and Carbone (1994) suggest that undergraduate research has a positive impact on undergraduate intellectual growth and personal satisfaction. Eddins, Williams, Bushkek, Porter and Kineke (1997)

found that participation in undergraduate research made it more likely that students mastered complex scientific concepts and developed critical and independent thinking skills (see also Sakalys, 1984). James (1998) noted that undergraduate research promoted the development of "deep thinking skills," which are of benefit to students proceeding on to graduate school. Peppas (1981), in conducting a survey of 37 students who had participated in undergraduate research, noted a positive relationship between the conduct of undergraduate research and graduate school placement.

Although there has been a considerable amount of literature on the benefits of an undergraduate research experience, very little of this literature has investigated the effects of such an experience on first-generation, low-income, college students. This is particularly surprising given that many scholars have noted that first-generation students (or those students where neither parent graduated from a college or university) will become an increasingly larger proportion of the college student population (Terenzini et al, 1996, p.17; Levine et al, 1989).[1] Moreover what little literature there is has not investigated the effects of a substantial undergraduate research experience on the student's successful entrance into graduate school, as well as the level of success that student enjoys while in graduate school.

This paper specifically addresses the relationship between participation in an undergraduate research internship and success in graduate school for students served by the Ronald E. McNair Program, a Department of Education (DOE) program. The program is designed to provide effective preparation for the entrance into and successful completion of a graduate school program by first-generation, low-income college students and students from under-represented minority groups. For the purposes of this study, *success* refers to the students' ability to secure admission into graduate school, as well as complete the graduate degree.

In order to address these issues, this paper is divided into three sections. In the first section we discuss the design and methodology of the project, particularly the sample composition, a description of the instrument, and the operationalization of the relevant variables. In the second section we provide some descriptive data on the characteristics of the various programs nationwide which resulted from a survey of 35 McNair programs, particularly with regards to the structure of the undergraduate research internship component of their programs, and the components directors thought were most effective. Then we investigate the relationships between the characteristics of the research internship and the degree of success experienced by the programs in placing students in graduate school programs. In particular, we hypothesize that programs that provide a more *rigorous* research experience are more likely to promote the success of their graduates in entering and persisting through graduate school. Third, based upon some of the observations made in sections 1 and 2, we offer some suggestions as to how to improve existing research internships.

Design and Methodology

Sample Composition

A questionnaire made up of twelve (12) items was distributed to the 157 McNair programs throughout the country. Forty-three programs responded (27% of the total), but only 35 of the responses were usable, given that eight of the programs were new and had not yet compiled any experience nor data on the actual operation of their research internships. Directors of the programs were asked to report on a variety of features of their research programs including: the number and types of workshops that are provided by the research program, the materials required of the students when submitting applications for acceptance into the research program, the required products of the

BEST COPY AVAILABLE

research internship, and the McNair directors' assessment of the effectiveness of the various components of the research internship.

Variables

A. Dependent Variable – Graduate School Success

The primary dependent variable for this study is the extent of graduate school success. Graduate school success is operationalized in two ways. The first involves the directors' assessments of how effective the research internship was in terms of facilitating three aspects of graduate school success: (1) admission or placement in a graduate program; (2) obtaining funding for graduate school; and, (3) completion of the graduate degree. Each of these three components was scored from 1 through 4, with 4 indicating the highest degree of effectiveness, and 1 the least. The three components were combined into a simple additive composite measure, where the scores of the three components were added together and divided by 3 to obtain an average score ranging from 1 to 4.

The second involved a single measure of success in graduate school placement by program, the ratio of program graduates who attended graduate school over the total number of program graduates. This yielded a proportion ranging from 0 to 1 where 1 was considered the highest degree of success and 0 the lowest.

B. Independent variables

To measure the extent to which McNair programs provide a *rigorous* research internship, we consider three features of the McNair research program: the number of workshops provided, the materials required to participate in the research program, and the types of completion requirements

BEST COPY AVAILABLE

for the program. Each of these dimensions measures a different aspect of the degree of rigor.

The first measure of the degree of rigor we employ is how demanding are the pre-entry and pre-admission requirements. More specifically, this measure, in turn is made up of four components: whether or not the program requires students to submit a description of research interests, a research abstract, a research design, and a research proposal. Respondents were asked to check if the item was required for submission. Each item was then scored, with a description of research interests (which is the most general and least defined of the four choices) scored as a "1". In turn a research abstract (a short statement of intent without fully developed design, timetable or proposed methodology) scored as a "2". The item *research design* was coded as a "3" in as much as it represented a more fully developed project (albeit without timetable or budget) and the item *research proposal* which represented a fully developed project design was scored as a "4". The individual program scores were then added together, creating a scale which ranged from 1 (which is least demanding) to 7 (a program which is most rigorous).

A second measure is the *number of research workshops*, which acts as an indicator of the degree to which programs are willing to train the students in the process of conducting research, as well as acclimating them to the demands of graduate school. To be sure, this measure does not capture the actual types of workshops conducted, but we assume that the more workshops there are, the greater is the commitment of the program to creating a rigorous experience for the students.

Finally, the third measure of rigor we employ is one that measures what the program expects from the student conducting research. In particular, using a Guttman scaling technique, we develop an ordinal scale that measures how demanding a program is in terms of the research product, based upon five items. These items appear in Table 1 and include whether or not a student was required

to: (1) submit a research proposal; (2) submit a complete research design; (3) submit a complete research manuscript; (4) present the manuscript at a research conference; and finally (5) to submit their manuscript for publication. Although there is some reason to expect that these items form a natural scale (for instance a proposal and a design precede a finished research manuscript, which in turn precedes presentation and publication) to determine this, we employ a Guttman procedure to assess whether or not these five items form a scale (for a discussion of this procedure, see Mannheim and Rich, 1991). The procedure is illustrated in Table 1 where six consistent patterns were identified.

(Table 1 about here)

Twenty-five of the thirty-five cases fell into one of the six consistent patterns, and the remaining ten fell into the error patterns. In short, this rendered a coefficient of reproducibility of .92, well above the standard to determine whether a scale exists. Thus, a six point scale was produced, where "1" represented the lowest degree of expectations concerning student product, and "6" the highest.

Results

Before directly investigating the relationship between the degree of rigor of the research experience and success in graduate school, a brief examination of some of the self-reported directors' data is of some value here. Tables 2 through 5 present directors' reports of what their programs do and how they evaluate the effectiveness of the components of their programs. Table 2 reports the McNair directors' estimation of the effectiveness of various components of their programs as

BEST COPY AVAILABLE

expressed by an average score ranging from 1 (fairly effective/not effective) to 4 (extremely effective). Also reported is the number of programs (of the thirty-five) engaged in these activities. Directors estimated that the most effective components of their programs were the workshops/seminars (2.93) followed by faculty mentoring (2.91), graduate school visit (2.91), and program advising and counseling (2.82). Peer mentoring (the use of student mentors) was scored the lowest (2.39), but was also the activity that was least often employed (only 18 of the 35 programs used peer mentors). Interestingly, the GRE (Graduate Record Examination) preparation workshop, although used by most programs, was also considered the least effective part of the McNair programs (2.48). This raises questions about the quality, structure, and effectiveness of GRE workshops as currently employed by McNair programs.

(Table 2 about here)

Tables 3 through 5 relate to the research component of the McNair programs, and how effective these were perceived by the directors. Table 4 reports the types of materials required to be submitted by the students applying to the research internship. The largest proportion, 65.7% require a research proposal, and 54.3% require a description of research interests, whereas only 25.7% require a design. This indicates that most programs are not particularly demanding of their students in the requirements to participate in the research internship. In Table 4, outcomes most often required of the research internship were a proposal (62.9%) and a complete research paper (68.6%). However, most programs did not require presentation of the research at a university conference, evidenced by only 48.6% of respondents reporting that they require students to present at their

universities. Further, only 25.7% of respondents reported their students present outside of the university at regional or national conferences. The latter result is surprising given the proliferation of regional and national McNair conferences which afford numerous opportunities for McNair scholars to present their work. From Table 4 it is also apparent that most programs do not urge their students to submit their work for publication in a scholarly journal. This is illustrated by the fact that only 31.4% (or 11 of 35) respondents require internship participants to submit finished products for publication in a scholarly journal. In fact, a smaller percentage (14.3%) mandates publications. Since 68.6% of the respondents require a complete research manuscript or paper (as show in Table 4), one wonders why some programs do not encourage their students to seek publication outlets or why they do not provide these publication outlets to their research interns themselves.

(Table 3 about here)

(Table 4 about here)

Finally, Table 5 shows directors' evaluations of the effectiveness of research internships. Directors were asked to rate the effectiveness of the research internship in promoting successful graduate school entrance, completion, and funding. Of the three outcomes reporting graduate school success, program directors believed that the research internship was most effective in graduate school admittance and placement of McNair students (3.16), followed by the completion of degree (2.77), and funding (2.69).

(Table 5 about here)

Table 6 reports the results of conducting an ordinary least squares regression analysis where the dependent variable (the directors' composite assessment of the degree of effectiveness of the research internship) is regressed against three independent variables (the Guttman scale score for the degree of rigor in research product, what students submit for acceptance into the research program, and the number of research oriented workshops). In addition to standardized coefficients, tests of significance and collinearity diagnostic tests are also reported, as well as a goodness of fit measure, the adjusted r-square.

(Table 6 about here)

As indicated in Table 6, the measure of higher expectations regarding research product is positively related to the dependent variable. Further, this relationship is statistically significant (at $p \leq .10$). This result lends support to the notion that the more demanding the research program in terms of product, the more this assists student success in graduate school. Second, the degree to which programs are demanding in terms of the materials that students submit when applying for admission into the research internship is also positively and significantly related to the directors' assessment of how effective the research program is in graduate school success (coefficient = .53). In other words, the more the program expects from a student upon entering the research internship (in terms of a developed proposal and research design), the more likely the research internship is considered successful by directors. Third, it is noteworthy that the sheer number of workshops is unrelated to the directors' perception of graduate school success. Moreover, the sign of the coefficient (-.30) indicates that the relationship is negative – in other words, the more workshops

BEST COPY AVAILABLE

there are, the less effective is the research internship in promoting graduate school success. This may be due to the potential for "overkill" and student fatigue caused by having too many workshops. Further, as indicated by the √VIF (variance inflation factor), the degree of multicollinearity is minimal – implying that the independent variables are relatively unrelated to one another. Finally, it should be noted that the model explains a respectable amount of the variance in the dependent variable (adjusted r-square = .14).

Of course the caveat is that these are the directors' perceptions of graduate school success, which may be distinct from actual levels of success. Table 7 reports the results of regressing actual levels of graduate school placement success (defined as the proportion of the program's graduates having successfully entered a graduate program) against the same three independent variables which appeared in Table 6. From the results illustrated in Table 7, it appears that the effect of higher expectations for the research product does not necessarily translate into graduate school placement success. Not only is the Guttman scale score for the degree of rigor in the research product unrelated to graduate school placement rates, but the sign is negative – in other words, the greater the expectations for the research product, the less likely the program experiences high graduate placement rates. However, since the relationship is not statistically significant, nothing conclusive can be claimed.

(Table 7 about here)

Again as in Table 6, the number of workshops is also unrelated to graduate school placement success (coefficient = -.15). However, the relationship between the degree to which programs are demanding in terms of the materials that students submit when applying for admission into the

research internship and actual graduate school placement rates are strongly and positively related. This result, coupled with the result reported in Table 6, implies that early exposure to the research process is a crucial determinant of success in entering graduate school, *not* just the degree of rigor in the research internship itself. This suggests that early and continuous exposure to the process of conducting research, coupled with high expectations upon entering the research internship, better prepares students for graduate school than lower expectations when entering the research internship. Further, as indicated by the √VIFs (variance inflation factors), the degree of multicollinearity is minimal – implying that the independent variables are relatively unrelated to one another. However, the model only explains a limited amount of the variance in the dependent variable (adjusted r-square = .07), which suggests that there are other factors yet to be considered which contribute to the level of success in graduate school placement.

Discussion and Implications: Towards improving the undergraduate research experience

The above findings suggest that the undergraduate research internship does appear to be related to graduate school placement. Although, there appears to be a gap between what directors perceive as the extent to which the research experience is successful and the actual rates of success (at least in terms of placement rates). This might suggest that the research internship has little to do with successful entrance into graduate school. However, this rather disconcerting finding may be due to the fact that there are a number of factors associated with graduate school placement beyond participation in a research internship. Nonetheless, the demonstration of the existence of a systematic (albeit weak) relationship between preparation for the research internship and graduate school success does indicate that participation in research does matter.

BEST COPY AVAILABLE

We contend that the existence of a research internship is not by itself sufficient to promote successful entrance and progress in graduate school. Although the greater the degree of rigor reported by McNair directors appears to be unrelated to actual graduate school entrance, this result may be due to the disparate ways in which "rigor" is reported. For instance, "publication" as a requirement of the research internship, can range from a non-refereed newsletter to a professional journal. Thus, self reports by McNair directors may not accurately reflect the actual degree of rigor required by their relative programs.

Based upon the above results, three observations provide some insight as to the actual degree of rigor in current McNair research programs. First, most programs require relatively little in terms of materials submitted for application to the research internship (see Table 4). Most programs only require a description of research interests as opposed to a fully developed research plan or design. Second, although most programs require a complete research manuscript, not all do. Even more striking, remarkably few programs require presentation of research findings outside of the university in which they are situated (a mere 25.7%), and very few require either submission or publication of the manuscript in a scholarly journal. Third, the more rigorous the application process (which suggests a longer and more sustained effort at training students in the process of conducting research), the more likely the student successfully enters a graduate program – a relationship born out by the results reported in Table 7 above.

Taken together, these observations suggest that three key elements are generally absent from many McNair programs conducting the research internship. These three elements – preparation, presentation, and publication – are the keys to a successful undergraduate research experience. Early preparation is important because the earlier the student is acclimated to the research process, the

BEST COPY AVAILABLE

more likely the student will become familiar with the requirements of graduate school. This involves not only exposing the student to the process of conducting research during the research internship, but also exposing the student to the entire process of applying for funding for the research project. Second, once the research project is completed, it is very important for the student to have an opportunity to publicly present his/her work. Presentation experience is important because it provides the student with practice at communicating the principal findings of his/her research in a parsimonious way, an invaluable skill when in graduate school. Further, presenting their work in a forum outside of the safe haven of their own home institution gives students confidence in their own skills and makes them realize that they stack up very well relative to their peers. Third, submitting the paper for publication and/or having the paper published provides the students with closure to their research experience (as well as looking very good on their academic vitae).

What can be done to facilitate a beneficial undergraduate research experience? In this section of the paper we wish merely to outline several lessons on the research internship we have learned from *Truman* State University's program, particularly regarding components of the research internship that facilitate student pre-internship preparation, student presentation, and student publication.

First, to facilitate student preparation for conducting research, an important component of the *Truman* State University McNair program is the "pre-research internship" for sophomore students. Students are admitted to the Truman McNair program as sophomores and after completing a series of introductory workshops (such as time management, financial aid, etc.) during the school year. They are then required to participate in a pre-research internship held for a three week period in May (between the official end of the Spring term and the beginning of the Summer semester).

BEST COPY AVAILABLE

During this time, the students participate in a series of research oriented workshops designed to introduce them to learning how to put together a fundable research proposal. The student is not required to complete the "perfect" proposal, just to engage in a proposal writing exercise. This draft "proposal" is then presented publicly to a group of observers, who offer the student a series of constructive criticisms. We have found that successful completion of the pre-research internship helps students focus their respective projects, and to begin to think in the systematic way required for writing an effective research proposal.

Second, the opportunity to present a research project provides the student not only with a line on his or her academic vitae, but also with the confidence that he or she can make an oral presentation effectively. Further, multiple opportunities to present sharpens the student's oral presentation skills, an invaluable skill in graduate school, where multiple oral presentations are the norm. To provide multiple presentation opportunities, the student who participates in the research internship at Truman State University is required not only to present his or her draft research proposal as a sophomore, but also to present his or her finished product once he or she completes the summer research internship. The student presents first at the "mock presentations" which are run as a dress rehearsal at the end of the summer research internship, and again the following week at the Pennsylvania State University McNair Conference, which is typically held in the first weekend of August. The students also have two additional opportunities to present their research in the fall, after the summer research internship, at the Heartland McNair Research Conference held in Kansas City, Missouri (usually in September) and a local conference held at Truman State University (in October). Further, students are encouraged to continue collaboration with their mentors on other projects, and this has typically resulted in additional research presentations. The key is to provide

as many opportunities to present as possible, a task which has been made easier by the existence of numerous regional McNair conferences.

Of course, one of the most critical constraints facing McNair programs in providing research presentation opportunities is budgetary. Many of the national McNair conferences are too far away for programs to effectively fund student participation. One possible way to overcome this dilemma is to promote small regional McNair conferences such as the Heartland McNair conference which is essentially a consortium of McNair programs in Missouri, Kansas, Nebraska, Iowa and Oklahoma. This provides an opportunity for students participating in McNair programs to present their work "externally" but where travel costs are not prohibitively high. The proliferation of such regional conferences will provide a cost effective way for McNair programs to increase the number of research presentation opportunities for students.

Third, it is crucial that the student be *required* to publish his or her manuscript. This not only provides the student with a writing sample, which most graduate programs now require, but also a publication appearing on the student's vitae is a very large plus when applying to a graduate school programs. ***Every*** student who participates in the Truman State University McNair summer research internship is required to submit his or her finished manuscript to a refereed journal. To facilitate this, the Truman State University McNair program publishes the *McNair Scholarly Review*, which has appeared every year since 1995. Every manuscript undergoes a standard review process, and is refereed by two faculty members (a fact which we strongly encourage the students to mention in their personal statements). Students also have the option of submitting their work to other refereed journals.

How effective is the Truman summer research program? Although it is difficult to assess

BEST COPY AVAILABLE

precisely the effectiveness of the research internship, Truman McNair alumni, who were either currently enrolled in or graduated from graduate school were surveyed. They were asked to anonymously assess the extent to which the experience the students had in the summer research internship was effective in assisting with graduate school placement, obtaining funding for graduate school, and completing a graduate school degree. As indicated in Table 8, Truman alumni consistently gave high marks to the summer research internship, rating it higher than the marks directors gave their own programs, in terms of the impact the research internship had on assisting graduate school placement, obtaining funding, and completing the graduate school degree.

(Table 8 about here)

Conclusion

Although it appears from the first part of this analysis that there generally did not appear to be a strong relationship between the degree of rigor and graduate school success, this may be due to the fact that most McNair programs are not particularly demanding when it comes to the research internship. From the survey of McNair programs, it is apparent that most programs require relatively little in terms of materials submitted for application to the research internship, do not require the presentation of research findings outside of the university in which they are situated, nor require either submission or publication of the manuscript in a scholarly journal. It has been the experience of the Truman State University McNair program that these three elements, *preparation, presentation* and *publication* are the real keys to graduate school success.

BEST COPY AVAILABLE

Table 1: Guttman Scaling Technique, Consistent Patterns for Five Items Comprising the Degree of Expectations for Research Product

Research Proposal Required? 0=No 1=Yes	Research Design Required? 0=No 1=Yes	Complete Manuscript Required? 0=No 1=Yes	Research Presentation Required? 0=No 1=Yes	Submission for Publication Required? 0=No 1=Yes	Score	Number of Respondents Falling Into Consistent Patterns
0	0	0	0	0	1	5
1	0	0	0	0	2	0
1	1	0	0	0	3	7
1	1	1	0	0	4	7
1	1	1	1	0	5	3
1	1	1	1	1	6	3

Coefficient of Reproducibility = .92

Table 2: Directors' Estimated Effectiveness of Various Components of McNair Programs						
	Faculty Mentors	Graduate School Visit	Peer Mentoring	Program Advising/ Counseling	GRE Preparation Workshop	Workshops/ Seminars
Average Score	2.91	2.91	2.39	2.82	2.48	2.93
St. d.	.88	.84	.99	.77	1.02	.73
N	33	33	18	33	29	27

(Score 1-4)

Table 3: Reported required materials submitted by students to apply for research internship				
	Description of Research Interests	Research Proposal	Research Abstract	Research Design
Percent Reporting They Require This Item	54.3%	65.7%	31.4%	25.7%
N	19/35	23/35	11/35	9/35

Table 4: Reported Required Products of Primary Research Internship							
	Research Design	Proposal	Complete Research Paper/ Manuscript	Presentation of Research at a Local University Conference	Presentation of Research at Regional/ National Conference	Submission of Publication in a Scholarly Journal	Publication of Manuscript in a Scholarly Journal
Percent Requiring Product	51.4%	62.9%	68.6%	48.6%	25.7%	31.4%	14.3%
N	18/35	23/35	24/35	17/35	9/35	11/35	5/35

BEST COPY AVAILABLE

Table 5: Directors' Estimated Effectiveness of Research Internship in Promoting Graduate School Success			
	Effective for Admission/ Placement in Graduate Program	Effective for Obtaining Funding for Graduate School	Effective for Completion of Graduate Degree
Average Score	3.16	2.69	2.77
St. d.	.95	1.00	.99
N	32	29	31

(Score 1-4)

Table 6: Standardized Coefficient Estimates and Collinearity Diagnostics for Director's Estimation of Effectiveness of Research Internship			
Variable	Beta	√VIF	T-statistic (absolute value)
Guttman Scale Score for Degree of Rigor in Research Product	.33	1.01	1.83*
What Students Submit for Acceptance Into Research Program	.53	1.05	1.80*
Number of Research Oriented Workshops	-.30	1.05	.96

Adjusted R-Square = .14
N=35

* *significant at p ≤ .10*
** *significant at p ≤ .05*

Table 7: Standardized Coefficient Estimates and Collinearity Diagnostics forReported Program Graduate School Placement Rates			
Variable	Beta	√VIF	T-statistic (absolute value)
Guttman Scale Score for Degree of Rigor in Research Product	-.15	1.01	.80
What Students Submit for Acceptance Into Research Program	.41	1.05	2.13**
Number of Research Oriented Workshops	-.15	1.05	.77

Adjusted R-Square= .07
N=35

* *significant at p ≤ .10*
** *significant at p ≤ .05*

Table 8: Truman State University Alumni and McNair Directors' Estimated Effectiveness of Research Internship in Promoting Graduate School Success Compared			
	Effective for Admission/ Placement in Graduate Program	Effective for Obtaining Funding for Graduate School	Effective for Completion of Graduate Degree
Directors' Scores	3.16	2.69	2.77
Truman Alumni's Scores	3.17	3.00	3.00

(Score 1-4)

References

Billson, Janet M. and Terry, Margaret Brooks (1982). In search of the silken purse: Factors in attrition among first-generation students. *College and University* 10 (1): 57-75.

Eddins, Stefka G. Nikolova, Williams, Douglas F., Bushek, Dave, Porter, Dwayne, and Kineke, Gail(1997). Searching for a prominent role of research in undergraduate education: Project Interface. *Journal on Excellence in College Teaching* 8(1): 69-81.

James, Philip (1998). Progressive development of deep learning skills through undergraduate and postgraduate dissertations. *Educational Studies* 24(2): 95-105.

Levine, Arthur (1989). *Shaping Higher Education's Future: Demographic Realities and Opportunities, 1990-2000.* San Francisco: Jossey-Bass.

Mannheim, Jarol and Rich, Richard (1992). *Empirical Political Analysis.* New York: Longman.

Nagda, Biren A., Gregerman, Sandra R., Jonides, John, von Hippel, William, Lerner, Jennifer S. (1998). Undergraduate student-faculty research partnerships affect student retention. *Review of Higher Education* 22(1): 55-72.

Peppas, Nicholas. A. (1981). Student preparation for graduate school through undergraduate research. *Chemical Engineering Education* 15(2): 135-37.

BEST COPY AVAILABLE

Sakalys, Jurate A. (1984). Effects of an undergraduate research course on cognitive development. *Nursing Research* 33(3): 290-295.

Terenzini, Patrick. T., Springer, Leonard, Yaeger, Patricia M., Pascarella, Ernest T., and Nora Amaury(1996). First-generation college students: Characteristics, experiences and cognitive development. *Research in Higher Education* 37(1): 1-21.

Tinto, Vincent (1975). Dropout from higher education: a theoretical synthesis of recent research. *Review of Educational Research* 45(1): 89-125.

Tinto, Vincent (1987). *Leaving College: Rethinking the Causes and Cures of Student Attrition.* Chicago: The University of Chicago Press.

Volkwein, J. Fredericks; Carbone, David A. (1994). The impact of departmental research and teaching climates on undergraduate growth and satisfaction. *The Journal of Higher Education* 65(2): 147-159.

York-Anderson, Dollean and Bowman, Sharon L. (1991). Assessing the college knowledge of first-generation and second-generation college students. *Journal of College Student Development* 32(2): 116-122.

Notes

1. There have been different definitions of "first-generation" college student in the literature. Fuji A Adachi, for instance, defined "first generation college student" as "students from families with at least one parent who had graduated from college." A more common definition of first-generation is that used by Billson and Terry (1982), in which students were identified as first-generation if neither of the student's parents attended college or a university at all. Thus parental education was considered both as a dichotomous variable – no college versus one or more parents with some college; and as a trichotomous variable, with parents having no college versus one or both parents with some college but no degree (second-generation students) versus college graduate parents (second-generation graduate) in which one or both parents completed a degree. In doing so, Billson and Terry (1982) were able to test for the effects of both parental experience with higher education as well as the presence of at least one parental role model who had completed a college degree. York-Anderson and Bowman (1991) employed a variation of the Billson and Terry definition by identifying first-generation students as children whose parents nor siblings attended college for one year.

In this study we employ the definition used by the Department of Education where first-generation college student is defined as where neither parent graduated from a four year college.